

Evaluating the Effectiveness of Digital Game-Based Learning in Second Language Vocabulary Acquisition

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Abstract. Success in language learning is largely dependent on the ability to acquire vocabulary in the second language. Sadly, vocabulary acquisition appears to be one of the more challenging aspects of language learning. In recent times, educators try to facilitate second language vocabulary acquisition using educational technology. One of such tools used is game-based learning.

This study seeks to explore the effectiveness of digital games in second language vocabulary learning.

Author Keywords

Digital games; second language learning; vocabulary acquisition.

ACM Classification Keywords

Information systems applications~Multimedia information systems; Applied computing~Arts and humanities; Applied computing~Education.

Introduction

Language teachers generally agree that a student's vocabulary base contributes immensely to their ability to progress in their language learning endeavors. Sadly,

teachers also note that vocabulary acquisition is challenging for students. The recent times have seen the application of varied technology in the language classroom, alongside research into these technologies and their effectiveness. For instance, Domalewska (2014) explored the effectiveness of blogging as a collaborative tool in the language classroom. Bourne (2014) conducted research on the effectiveness of online translation tools and technology in language learning. While there have been many studies on technology and its relationship to language learning, there have been limited studies on the effectiveness of digital games on vocabulary learning. In fact, Mayer (2019) pointed out that although there is an optimistic view of educational games, there is little evidence to test those claims. The majority of the studies conducted so far have focused on the benefits of digital games in vocabulary acquisition. For instance, Abrams et al. (2014) found that digital games promote problem solving and collaboration. Another study found that digital games promote the learner's motivation and engagement (Rieber et al., 2014). Still other studies have been focused on finding elements that make a digital game effective. The study conducted by Abrams and Walsh (2014) noted that immediate feedback and sense of accomplishment are elements that contribute to a successful digital game for vocabulary acquisition. Chen et al. (2018) carried out a meta-analysis of primary studies that occurred between 2003 and 2014. Their work found that "the effects of digital game-based learning varies with game design features but not with learners' age or background" (Chen et al. 2018).

With the foregoing in mind, it became imperative to have a research study that addresses the following questions:

1. In what ways are the currently available evaluation methods for measuring the effectiveness of digital game-based learning in vocabulary acquisition lacking?
2. What are the most important parameters that should be included in developing a standardized evaluation methodology that measures the effectiveness of digital games for vocabulary acquisition?

3. How will effective and appropriate evaluation methods contribute to the field of digital game-based vocabulary learning?

All et al. (2014) analyzed current methods for evaluating the effectiveness of digital games. Their study found that these methods were not standardized and as a result were not reliable. The paper also noted that there was limited research in the area of the effectiveness of digital games for skill-based learning outcomes including vocabulary acquisition in language learning. This lack of standardization is evident in the paper by Reinder and Wattana (2014). Their study reported on the effects of playing digital games on player's willingness to communicate. However, the participants in the study were of different language proficiency levels, which may have affected the results.

A valid study on the effectiveness of digital games in vocabulary acquisition will have to follow a standard procedure. All et al. (2016) laid out best practices for a study that evaluates the effectiveness of digital game-based learning in vocabulary acquisition. According to the authors, the parameters for a standardized study include that the experimental study must have an experimental group and a control group, with participants being randomly assigned to either group. There should be a pre-test, a post-test and a follow-up study test. The pre-test and post-test should be as similar as possible. The suggested sample size for each group is a minimum of 20 participants, and conditions between each group should be as similar as possible. These suggestions form a bedrock for the present study.

An effective and standardized methodology will create the opportunity to compare results, and the quality of instructional methods across studies. It will set a baseline for quality and it would improve game design (All et al., 2016).

Methodology

In an effort to produce results that are valid and generalizable, this study endeavors to follow the best practice guidelines. The **null hypothesis** for the study states that

digital games are not effective for vocabulary acquisition in second language learning. The **alternative hypothesis** states that digital games are effective in second language vocabulary acquisition. To test these hypotheses, the study uses a dual methodology. The first involves the use of surveys, while the second is an experimental study.

Survey

The purpose of the survey is primarily to establish whether language teachers and students consider digital games effective in vocabulary acquisition. There were two surveys, one for the teachers and the other for the students. The respondents were drawn from a French language school (Alliance Française, Enugu, Nigeria). Five (5) questionnaires were retrieved from the French language teachers.

All learners of different proficiency levels were invited to participate. Sixty (60) hardcopy survey questionnaires were sent out (based on the number of available registered students) but only 48 were retrieved from the students. The responses were then analyzed to determine the respondents' opinions on the effectiveness of digital games for vocabulary learning.

Experimental Study

The experimental study is the major part of this work. It involved recruiting volunteers from Alliance Française, Enugu. All volunteers were of the same language proficiency level, which is A2 (Elementary) level. The study lasted a period of six (6) weeks. There were a total of six (6) volunteers in this study, randomly assigned to either an experimental group or a control group, three in each group. Each week, there were four (4) game-based learning sessions with the volunteers in the experimental group. Each session lasted for thirty (30) minutes. At the beginning of the study, all volunteers were required to take a pre-test. About four (4) weeks into the study, the volunteers took a post-test and the follow-up study test was taken in the final week of the study. No games were developed for this study. Rather, the online games found at www.french-games.net were used for the purpose of this study.

Results

The results of the study will be discussed in two separate sections, one for the surveys and the other for the experimental study.

Survey Results

Teacher Perspective Survey Results

Five teachers participated in this survey. The survey questions are outlined below for ease of reference in the subsequent pages.

Table 1. Teacher Perspective Survey Questions

S/N	Question
1.	How many years of language teaching experience do you have?
2.	Do you use games in the classroom?
3.	Do you use digital games in the classroom for vocabulary acquisition?
4.	If you use digital games for vocabulary acquisition, how effective do you think they are in vocabulary acquisition?
5.	Please give reason(s) for your answers above.
6.	If you do not use digital games for vocabulary acquisition, how effective do you think they will be in vocabulary acquisition?
7.	Please give reason(s) for your answer.

8.	Any other thoughts on the subject of the effectiveness of digital games in vocabulary acquisition?
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The teachers had varying number of years of experience in language teaching, from 2 years to 10 years+. All the teachers agreed to using games in the classroom. However, as at the time of this survey, none of the teachers had ever used digital games for vocabulary acquisition. These results are illustrated with the chart in figure 1 below.

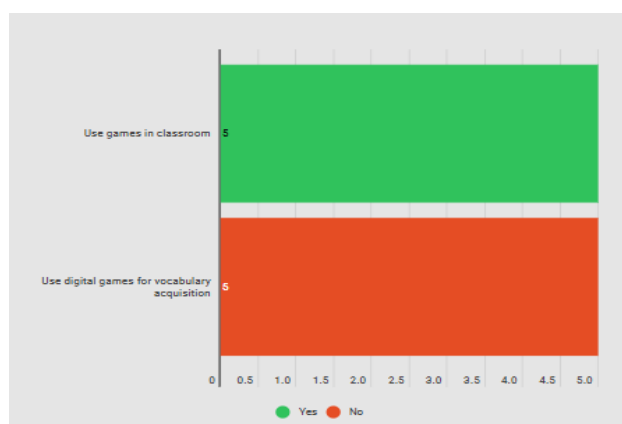


Figure 1. Stacked chart showing the responses on game usage vs. digital game usage for vocabulary acquisition.

Given that none of the teachers had used digital games for vocabulary acquisition, there were no responses to questions 4 and 5. Interestingly, though, all the teachers thought that digital games would be effective in vocabulary acquisition. This was rather surprising and gave rise to the question of why these teachers were not using digital games even though they believed they will be effective in vocabulary acquisition¹. Figure 2 illustrates this with a pie chart.

¹ Casual conversations with them revealed that this was primarily because they were sticking to the same pedagogical methods, without exploring other options.

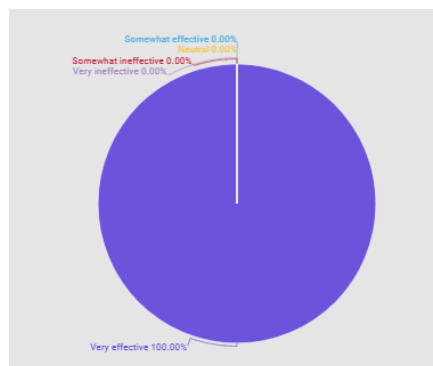


Figure 2. Pie chart showing teachers' perceived effectiveness of digital games in vocabulary acquisition.

The teachers had several reasons for concluding that digital games will be effective for vocabulary acquisition, including the following:

1. Games are interactive and fun
2. They stimulate memory retention
3. They are easy to use
4. They appeal to the generation of technology users

Student Perspective Survey Results

The survey questions are outlined in table 2 below.

Table 2. Student Perspective Survey Questions

S/N	Questions
1.	For how long have you been learning a foreign language?
2.	Do you use games in the classroom?
3.	Do you use digital games in the classroom for vocabulary acquisition?
4.	Regardless of your answer in question 3 above, how effective do you think digital games are in vocabulary acquisition?

5.	Please give reason(s) for your answer.
6.	In your opinion, what is the ideal way to use a digital game for vocabulary acquisition?
7.	Any other thoughts on the subject of the effectiveness of digital games for vocabulary acquisition?

The responses gathered from the students were a little more robust than those of the teachers, perhaps because there were more student responses than teacher responses.

The number of years spent learning a foreign language varied from 2 days to all of life. 37.5% of students had used games in the classroom while 62.5% had not used them. In response to the question of whether they had used digital games for vocabulary acquisition, 10.42% responded in the affirmative, while 89.58% responded in the negative². The stacked chart in figure 3 illustrates these results.

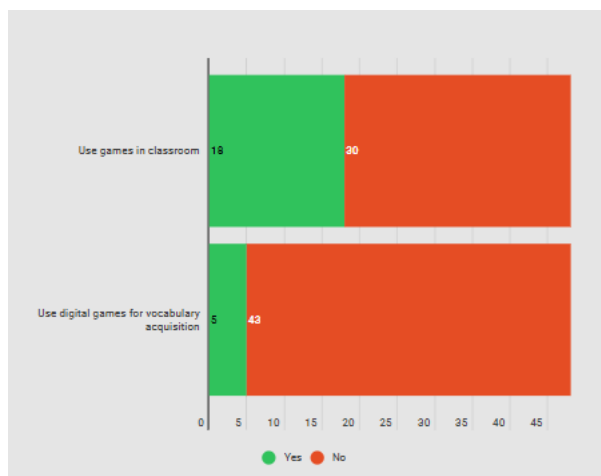


Figure 3. Stacked chart showing students' responses on game usage vs digital game usage for vocabulary acquisition.

² At the point of conducting the student surveys, the study sessions had already kicked off. Hence, the percentage of students who responded in the affirmative were most likely participants in the experimental study.

Regardless of their digital game usage for vocabulary acquisition status, 81.25% of students believed digital games are very effective in vocabulary acquisition, 4.17% thought they were somewhat ineffective, 12.50% were neutral, 2.08% thought they were somewhat ineffective while 0% thought they were very ineffective (refer to the pie chart in figure 4).

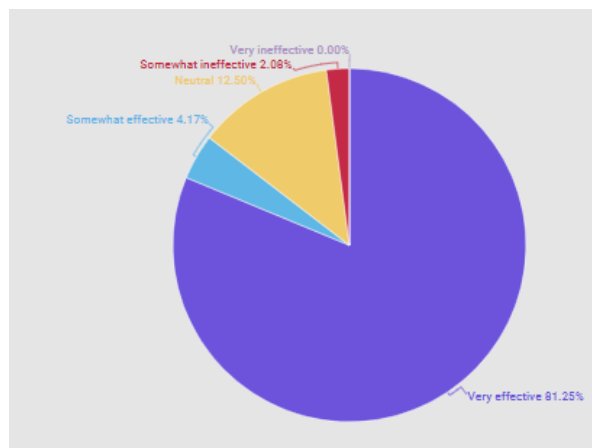


Figure 4. Pie chart showing students' view on the effectiveness of digital games in vocabulary acquisition.

Based on the results generated in both the teacher perspective surveys and the student perspective surveys, it is clear that digital games are considered effective for vocabulary acquisition.

Experimental Study Results

To measure their progress over the weeks of the study, the volunteers were required to take a pre-test, a post-test and a follow-up study test. Each test has a total of twenty (20) questions and was thus graded with 20 as the maximum possible score. The results obtained have been de-identified and are shown in table 3 below.

Table 3. Results of three different tests taken by students to monitor progress.

	Conditions
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	Control group scores			Experimental group scores		
	C1	C2	C3	E1	E2	E3
Pre-Test	11	16	8	9	12	11
Post-Test	12	16	13	11	15	15
Follow-up Study Test	12	15	14	14	15	18

An analysis of the mean of these results shows a continuous improvement from one test to another for volunteers in the experimental group. This can be seen in table 4.

Table 4. Mean/Average of test results for each group

	Mean score for control group	Mean score for experimental group
Pre-Test	11.67	10.67
Post-Test	13.67	13.67
Follow-up Study Test	13.67	15.67

At the beginning of the study, the volunteers in the control group outperformed those in the experimental group. After about 4 weeks into the study, the experimental group was at par with the control group, both averaging 13.67 in their test scores respectively. Even more impressive is the fact that those in the experimental group outperformed those in the control group in the follow up study test, with an average of 15.67 against the 13.67 average of the control group volunteers.

These scores were further analyzed with hypothesis testing to generate the p-values in table 5. The threshold value set for the study was 0.05.

Table 5. P-values for hypothesis testing.

	P-value	Threshold (alpha)
Pre-Test	0.708991	0.05
Post-Test	1.000000	0.05
Follow-up study Test	0.250815	0.05

Because the p-values are greater than the threshold value and are statistically insignificant, the null hypothesis cannot be rejected.

Limitations

There are several limitations associated with this study, foremost of which is the limited number of volunteers in the experimental study. Because of this limitation, the results of the experimental study may be neither valid nor generalizable to the entire population.

Another limitation is the short-term nature of the study, spanning over only 6 weeks, which may not be enough to arrive at conclusive results. A more thorough study may involve months of research and follow-up on participants.

Yet another limitation lies in the fact that only one geographical location was considered in this study. A localized study of this nature may not give results that are generalizable to the entire population given that certain local factors may influence results.

Future Work

Given the limitations associated with this study, there are areas of opportunity for future work. Any future work will endeavor to have more volunteers in the

experimental study. A minimum of twenty (20) participants is recommended (All et al. 2016). Having more participants will yield more valid and generalizable results. Future studies of this nature should last a longer time, perhaps over several months, during which the participants' progress can be monitored. A study that spans over a longer time is more likely to yield results that are more conclusive.

It is recommended that future work should study learners of different proficiency levels to ascertain if game-based learning is effective at all language learning levels, or if its effectiveness diminishes after a certain level of language mastery.

Conclusion

The surveys conducted in this study give evidence that digital games are effective in vocabulary acquisition. Although not currently using them in the classroom, all the teachers surveyed believe that digital games are very effective for second language vocabulary learning, and 81.25% of students surveyed were of the opinion that digital games are very effective for vocabulary acquisition. The experimental study produced insightful results that are open for further testing. The experimental group showed a continuous improvement in test result scores compared to the control group. However, a hypothesis testing of the mean scores did not produce statistically significant p-values. Hence, the null hypothesis cannot be rejected for this study. Future work on this area will be more extensive with the aim of categorically establishing where digital games lie on the effectiveness spectrum for second language vocabulary acquisition.

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Appendices

Appendix 1: Student Perspective Survey Questions

1. For how long have you been learning a foreign language? _____
2. Do you use games in the classroom?
 - a. Yes
 - b. No
3. Do you use digital games in the classroom for vocabulary acquisition?
 - a. Yes
 - b. No
4. Regardless of your answer in question 3 above, how effective do you think digital games are in vocabulary acquisition?
 - a. Very effective
 - b. Somewhat effective
 - c. Neutral
 - d. Somewhat ineffective

- e. Very ineffective
- 5. Please give reasons for you answer above _____
- 6. In your opinion, what is the ideal way to use a digital game for vocabulary learning in the classroom? _____
- 7. Any other thoughts on the subject of the effectiveness of digital games in vocabulary acquisition? _____

Appendix 2: Teacher Perspective Survey Questions

1. How many years of language teaching experience do you have? _____
2. Do you use games in the classroom?
 - a. Yes
 - b. No
3. Do you use digital games in the classroom for vocabulary acquisition?
 - a. Yes
 - b. No
4. If you use digital games for vocabulary acquisition, how effective do you think they are in vocabulary acquisition?
 - a. Very effective
 - b. Somewhat effective
 - c. Neutral
 - d. Somewhat ineffective
 - e. Very ineffective
5. Please give reason(s) for your answer above. _____
6. If you do not use digital games for vocabulary acquisition, how effective do you think they will be in vocabulary acquisition?
 - a. Very effective
 - b. Somewhat effective
 - c. Neutral
 - d. Somewhat ineffective

e. Very ineffective

7. Please give reason(s) for your answer. _____
8. Any other thoughts on the subject of the effectiveness of digital games in vocabulary acquisition? _____

Appendix 3: Student Perspective Survey Responses

1. Time spent learning a foreign language: From 2 days to All of life

2. Use games in the classroom

Yes	No
37.5	62.5

3. Use digital games for vocabulary acquisition

Yes	No
10.42	89.58

4. Effectiveness of digital games for vocabulary acquisition

Very effective	81.25%
Somewhat effective	4.17%
Neutral	12.50%
Somewhat ineffective	2.08%
Very ineffective	0%

5. Reasons for above answers

Reasons for very effective and somewhat effective choice	1. Makes learning fun 2. Improves vocabulary acquisition 3. Boosts memory 4. Boosts learners' self-confidence
Reasons for choosing neutral	1. It is not so important 2. No prior exposure to digital games
Reasons for choosing somewhat ineffective	1. Technology can be distracting
Ideal way to use digital games in the classroom	1. Using a projector and a laptop 2. In groups to encourage interaction 3. Daily; before class; during class; and after class 4. In teams, with a reward system for the winning team

Appendix 4: Teacher Perspective Survey Responses

1. Years of experience as a foreign language teacher: From 2 years to 10 years+

2. Use games in the classroom

Yes	No
100%	0%

3. Use digital games for vocabulary acquisition

Yes	No
0%	100%

4. *No responses*

5. *No responses*

6. Effectiveness of digital games for vocabulary acquisition

Very effective	100%
Somewhat effective	0%
Neutral	0%
Somewhat ineffective	0%
Very ineffective	0%

7. Reasons for choice of very effective

- a. Games are interactive and fun
- b. They encourage vocabulary learning
- c. They stimulate memory retention
- d. They are easy to use
- e. They appeal to the generation of technology users